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**PREDICTION OF TURNOVER INTENTIONS AMONG
CIVILIAN ENGINEERS EMPLOYED AT NAVY INDUSTRIAL
FACILITIES**

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**PREDICTION OF TURNOVER INTENTIONS AMONG CIVILIAN ENGINEERS
EMPLOYED AT NAVY INDUSTRIAL FACILITIES**

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FOREWORD

This research and development was conducted in support of work unit Z1169-PN.01 (Civilian Productivity Enhancement). A previous report issued under this work unit (NPRDC TR 84-10) described the development of a standardized, cross-validated questionnaire designed to measure the quality of work life and general organizational functioning as perceived by members of Navy industrial organizations. This report describes how this questionnaire was used to assess the quality of work life of an important segment of the civilian industrial work force: engineers. Such information is required by Navy managers in the design of effective organizational changes to improve organizational functioning and morale.

The results of this work are intended for use by the Navy industrial community.

J. W. RENARD
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SUMMARY

Problem

Navy managers in the Naval Material Command are concerned with the problem of recruiting and retaining qualified civilian engineers for its industrial activities. Previous research has indicated that (1) engineers in general want four things from their jobs: challenging work, competitive and equitable salaries, advancement based on merit, and fair supervision, and (2) those leaving government service complained about the lack of opportunities to do important and interesting work, inadequate compensation, and poor opportunities for advancement.

Purposes

The purposes of this research were to (1) examine the attitudes and perceptions of civilian engineers currently working in Navy industrial settings, (2) compare these attitudes and perceptions with those of paraprofessional technicians and wage-grade employees, and (3) relate these attitudes to turnover intentions among engineers.

Approach

In a previous effort, a questionnaire designed to measure the quality of work life and general organizational functioning as perceived by members of Navy industrial organizations was administered to respondents at two naval air rework facilities (NARFs). For this effort, the responses of the 289 NARF respondents who were engineers (N = 132), engineering technicians (N = 116), or wage-grade mechanics (N = 41) were analyzed using standard univariate and multivariate statistical procedures.

Results and Discussion

In general, the engineers reported less intrinsic job satisfaction, more impediments to their productivity, and less material satisfaction from their jobs than did the technicians and mechanics. The best predictors of turnover intentions among engineers were their overall attitude toward supervision and their overall level of material satisfaction. These findings are congruent with previous research on engineers.

Recommendations

It is suggested that:

1. The Office of Personnel Management consider further accelerating the pay schedule for engineers as a means to improve recruitment and increase retention.
2. Managers of Navy industrial facilities attempt to (a) improve the physical working conditions encountered by engineers (e.g., provide acoustical ceilings to reduce noise, dividers in open bays for privacy) and (b) examine supervisory practices to see if the quality of supervision can be improved.

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INTRODUCTION

Problem

Navy managers are concerned with the problem of recruiting and retaining civilian engineers for their industrial activities. They report that, while they have been able to hire newly graduated engineers of adequate quality, they are not able, even in the midst of a deep recession, to hire experienced engineers. Also, they report that they are losing excessive numbers of fully qualified, experienced engineers to better paying jobs in the private sector. The Navy hires inexperienced, engineering graduates; provides them with valuable experience; and then loses them to the private sector before it can reap the full benefit from its investment. These problems in recruitment and retention of qualified engineers will probably worsen as the economy recovers.

French¹ reviewed about 20 years of social science literature and identified four characteristics scientists and engineers want in their jobs: challenging work, competitive and equitable salaries based on merit, advancement based on merit, and fair supervision. These four characteristics are reflected in the reasons given by engineers who have left government service. Fully 80 percent of such engineers listed the opportunity to do important and interesting work in an environment of individual freedom and responsibility, and 60 percent, the inadequacy of both compensation and opportunities for advancement. Since French's data are somewhat dated, current attitudes of government engineers must be assessed to determine if the reasons listed above are still responsible for engineer turnover.

Purposes

The purposes of this effort were to (1) examine the attitudes and perceptions held by civilian engineers employed in Navy industrial settings, (2) compare these attitudes and perceptions with those of paraprofessional technicians and wage grade employees, and (3) relate these attitudes and perceptions to turnover intentions.

Background

A previous report described the development of a standardized, cross-validated questionnaire designed to measure the quality of work life and general organizational functioning as perceived by members of Navy industrial organizations.² The Michigan organizational assessment questionnaire³ was modified and administered to a sample of employees at two Navy air rework facilities (NARFs). The questionnaire was designed to assess general attitudes, job facets, task and role characteristics, work group functioning, supervisory behavior, pay, organizational characteristics, and physical characteristics of the work space. Of respondents returning the questionnaire (N = 496), about half were engineers and engineering technicians. Fifteen factor analyses were performed on the

¹French, W. The personnel management process: Human resources administration (2nd. Ed.). Boston: Houghton Mifflin Co., 1970.

²Farkas, A. J. The measurement of organizational functioning and quality of work life (NPRDC TR 84-10). San Diego: Navy Personnel Research and Development Center, December 1983. (AD-A136 791)

³Nadler, D. A., Cammann, C., Jenkins, G. G., & Lawler, E. E. (Eds.). The Michigan Organizational Assessment Package (Progress Report II). Ann Arbor, MI: Survey Research Center, 1975.

responses from each facility and the emerging factors used to create 34 factor-based scales:

1. Five general attitude (GA) scales: General job satisfaction, achievement motivation, organizational commitment, investment in current job, and job involvement.
2. Five job facet (JF) scales: Importance of sense of accomplishment/freedom/growth, satisfaction with sense of accomplishment/freedom/growth, satisfaction with interpersonal outcomes, sense of accomplishment/growth for good work, and supervisory recognition for good work.
3. Eight task and role characteristic (TRC) scales: Self-evaluation of performance, job challenge, self-control of work pace, job importance, necessity for cooperation and coordination, job meaningfulness, fair workload, and sense of job responsibility.
4. Three work group functioning (WGF) scales: Work group cohesion, work group concord, and group decision making.
5. Four supervisory behavior (SB) scales: Consideration, initiating structure, production emphasis, and sensitivity.
6. Four pay (P) scales: Individual determinants of pay, other determinants of pay, satisfaction with pay, and fairness of pay.
7. Three organizational characteristics (OC) scales: Lack of impediments to productivity, facilitation of productivity, and good communication.
8. Two physical characteristics of work space (PC) scales: Desirability of the work space and importance of desirability of the work space.

To isolate the basic dimensions underlying the first-order scales, they were submitted to factor analysis and results used to create five second-order, factor-based scales: intrinsic job satisfaction, supervision, interpersonal climate, organizational climate, and pay and habitability (material) satisfaction.

The assessed reliabilities of both the first- and second-order scales demonstrated their usefulness in assessing aspects of organizational functioning.

PROCEDURE

Sample

The sample consisted of 289 respondents from the original sample who were engineers (N = 132), engineering technicians (N = 116), or wage-grade mechanics (N = 41). The engineer sample included 24 aeronautical, 35 electrical/electronic, 22 industrial, 44 mechanical, and 7 unclassified engineers.

Analyses

One-way analyses of variance were performed on the 34 first-order or basic scales and 5 second-order or composite scales developed in the previous effort. Comparisons were made of: (1) engineers, technicians, and mechanics, (2) subtypes of engineers, and

(3) the engineers and technicians at one NARF with those at the other NARF. A regression analysis was performed to develop a working model of turnover intentions among the engineers.

RESULTS

Sample Demographics

Table 1, which provides the demographic characteristics of the sample, shows that there were no significant differences across the three occupational groups as to racial or gender composition--most of the sample were caucasian and male. However, there were significant differences among the groups on education and salary--the engineers were the most educated and highest paid of the three groups.

Table 1
Demographic Characteristics of Sample

Variables	Group			χ^2
	Engineers (N = 132) (%)	Technicians (N = 116) (%)	Mechanics (N = 41) (%)	
Sex:				
Male	96.2	93.1	92.7	1.43
Female	3.8	6.9	7.3	
Total	100.0	100.0	100.0	
Race:				
Asian	16.0	8.9	12.2	4.25
Black	4.8	8.9	4.9	
Hispanic	5.6	5.4	4.9	
Caucasian	73.6	76.8	78.0	
Total	100.0	100.0	100.0	
Education:				
High school diploma or GED	0.0	8.6	17.9	226.19*
Some college	5.4	85.3	74.4	
College degree	46.9	3.4	5.1	
Some graduate work	31.5	1.7	2.6	
Graduate degree	16.2	0.9	0.0	
Total	100.0	99.9	100.0	
Salary:				
Less than 23K	19.1	18.3	26.8	27.58*
23K to 26,999	16.8	38.3	36.6	
27K to 30,999	26.0	28.7	17.1	
Greater than 31K	38.2	14.8	19.5	
Total	100.1	100.1	100.0	

*p < .001.

Subsample Comparisons

Engineers With Technicians and Mechanics

The means for the 34 basic scales are shown in Table 2 and described below.

1. General attitudes. Three significant differences were observed for general attitudes. Engineers reported significantly less general job satisfaction than did either the technicians or mechanics. The engineers and technicians reported significantly more achievement motivation but less investment in their current jobs than did the mechanics.

2. Job facets. Two significant differences were observed for job facets. Engineers consider the sense of accomplishment/freedom/growth derived from their jobs to be significantly more important than do the mechanics. However, the engineers reported no more satisfaction with the sense of accomplishment/freedom/growth derived from their jobs than did the mechanics but significantly less satisfaction than did the technicians.

3. Task and role characteristics. Several significant differences were observed for task and role characteristics. Engineers reported that they were less able to evaluate their own job performance, had less self-control of their work pace, experienced less job meaningfulness, experienced less job importance, and perceived their workload as less fair than did either the technicians or mechanics. The engineers and technicians, however, did report more job challenge and a greater need for cooperation and coordination on the job than did the mechanics.

4. Work group functioning. The three groups did not differ significantly in work group functioning.

5. Supervisory behavior. The three groups did not differ significantly in supervisory behavior.

6. Pay. Four significant differences were observed for pay. Engineers reported less connection between both their individual and other determinants of pay and their actual pay level than did the technicians and mechanics. The engineers also reported the least satisfaction with their level of pay; both the engineers and technicians considered their level of pay less fair than did the mechanics.

7. Organizational characteristics. Engineers considered that organizational communication patterns were less conducive to productivity than did either the technicians or mechanics.

8. Characteristics of the work space. Engineers found the characteristics of their immediate work space less desirable than did either the technicians or mechanics.

Table 3, which provides the means for the five composite scales, shows that engineers reported less intrinsic job satisfaction, an organizational climate less conducive to productivity, and less material satisfaction than did the technicians and mechanics.

Subtypes of Engineers

Results of comparing the means of the four major subtypes of engineers (i.e., aeronautical, electrical/electronic, industrial, and mechanical) showed that they differed significantly on only one basic scale and the composite scale of which it was a component.

Table 2
Comparison Between Engineers, Technicians, and Mechanics
on Basic Scales

Basic Scale	Group			F
	Engineers (N = 132)	Technicians (N = 116)	Mechanics (N = 41)	
1. General attitudes				
a. General job satisfaction	4.84 (A)	5.47 (B)	5.69 (B)	11.41***
b. Achievement motivation	6.05 (B)	6.15 (B)	5.71 (A)	3.65**
c. Organizational commitment	5.96	6.06	5.97	< 1.00
d. Investment in job	3.64 (A)	3.98 (A)	4.91 (B)	11.84***
e. Job involvement	3.06	3.05	2.74	< 1.00
2. Job facets				
a. Importance of sense of accomp./freedom/growth	5.53 (B)	5.44 (AB)	5.03 (A)	2.96*
b. Satisfaction with sense of accomp./freedom/growth	4.94 (A)	5.40 (B)	4.93 (A)	5.89***
c. Satisfaction with interpersonal outcome	5.41	5.56	5.63	< 1.00
d. Sense of accomplishment/growth for good work	4.64	4.88	4.45	2.31
e. Supervisory recognition for good work	3.39	3.24	2.95	1.81
3. Task and role characteristics				
a. Self-evaluation of performance	5.02 (A)	5.55 (B)	5.50 (B)	7.19***
b. Job challenge	5.74 (B)	5.75 (B)	5.32 (A)	5.13***
c. Self-control of work pace	4.51 (A)	4.80 (AB)	5.17 (B)	2.92*
d. Job importance	5.24 (A)	5.58 (B)	5.57 (B)	4.71***
e. Necessity for cooperation and coordination	5.35 (B)	5.26 (B)	4.22 (A)	17.60***
f. Job meaningfulness	5.07 (A)	5.65 (B)	5.36 (AB)	8.64***
g. Fair workload	3.70 (A)	4.20 (B)	5.30 (C)	19.22***
h. Sense of job responsibility	5.73	5.96	5.97	2.86
4. Work group functioning				
a. Work group cohesion	4.77	4.92	4.75	< 1.00
b. Work group concord	4.52	4.23	4.27	1.37
c. Group decision making	4.55	4.55	4.54	< 1.00
5. Supervisory behavior				
a. Consideration	4.69	4.70	4.68	< 1.00
b. Initiating structure	4.74	4.93	4.90	< 1.00
c. Production emphasis	2.96	3.03	3.02	< 1.00
d. Sensitivity	5.29	5.24	5.16	< 1.00
6. Pay				
a. Individual pay determinants	4.22 (A)	4.84 (B)	4.44 (AB)	4.68***
b. Other pay determinants	3.63 (A)	4.45 (B)	4.61 (B)	8.68***
c. Satisfaction with pay	2.71 (A)	3.11 (B)	4.40 (C)	16.20***
d. Fairness of pay	3.32 (A)	3.37 (A)	4.74 (B)	14.42***
7. Organizational characteristics				
a. Lack of impediments to productivity	3.13	3.40	3.48	2.47
b. Facilitation of productivity	3.90	4.16	3.88	1.84
c. Good communication ^a	2.78 (A)	2.84 (AB)	3.04 (B)	2.98*
8. Characteristics of the work space				
a. Desirability of the work space ^a	2.03 (A)	2.41 (B)	2.60 (B)	9.74***
b. Importance of desirability of work space ^a	4.14	4.10	4.07	< 1.00

Note. Letters in parentheses, generated using Duncan's Test ($\alpha = .05$), are used to indicate means that differ significantly. For example, in line 2a above, the mean for the engineers (marked B) differs significantly from the mean for mechanics (marked A); however, the mean for the technicians (marked AB) does not differ from the mean for either the engineers or the mechanics. The F-statistic tests whether the means for three groups are equal, and Duncan's test then specifies which groups differ from which other groups. Since Duncan's test is more liberal than the F-test, it may indicate significant differences (e.g., the means for self-control of work pace and good communication), while the F-test just misses being significant.

^aRated on a five-point scale with a neutral point of 3.00.

*p < .10.

**p < .05.

***p < .01.

Table 3
Comparison Between Engineers, Technicians, and Mechanics
on Composite Scales

Composite Scale ^a	Group			F
	Engineers (N = 132)	Technicians (N = 116)	Mechanics (N = 41)	
Intrinsic job satisfaction	5.19 (A)	5.55 (B)	5.42 (AB)	6.14*
Supervision	4.53	4.55	4.39	< 1.00
Interpersonal climate	4.80	4.83	4.78	< 1.00
Organizational climate ^b	3.11 (A)	3.27 (AB)	3.54 (B)	5.13*
Material satisfaction ^c	2.47 (A)	2.71 (B)	3.32 (C)	18.98*

Note. Letters in parentheses were generated using Duncan's Test ($\alpha = .05$).

^aEach composite scale represents the combination of four or more basic scales.

^bRepresents the mean of three 7-point scales and one 5-point scale; ranges from 1.00 to 6.50, with a midpoint of 3.75.

^cRepresents the mean of two 7-point scales and two 5-point scales; ranges from 1.00 to 6.00, with a midpoint of 3.50.

* $p < .01$.

Since statistical theory indicates that two significant differences are expected due to chance variation rather than to real differences for the number of tests performed, these two differences probably do not reflect true differences. Therefore, the decision to combine the subtypes into a single engineer group for comparisons with technicians and mechanics appears fully justified.

Engineers at Two NARFs

When the engineers at the first NARF were compared with those at the second NARF, significant differences were observed on three basic scales--consideration, other pay determinants, and desirability of the work space. The engineers at the first NARF perceived their supervisors as slightly more considerate (4.87 vs. 4.36), perceived somewhat less connection between their actual pay level and other determinants of pay (3.41 vs. 4.03), and considered the characteristics of their work space less desirable than did the engineers at the second NARF (1.75 vs. 2.53). The latter difference was also reflected in the composite scale called material satisfaction, which included desirability of the work space (2.34 vs. 2.72). Since two differences might be due to chance and since the differences on the supervisory behavior and pay scales were only marginally significant, they probably do not reflect true differences. On the other hand, the differences for the characteristics of the work space scale was highly significant ($F(1,129)$

= 28.15; $p < .00005$); this factor probably represents the only true difference between the engineers at the two locations.

Technicians at Two NARFs

In contrast with the engineers at the two NARFs, the technicians at the two locations differed significantly on 16 of the 34 basic scales and 4 of the 5 composite scales. These differences are shown in Table 4. In general, the technicians at the first NARF expressed more positive attitudes than did those at the second NARF. The technicians at the first NARF reported significantly more achievement motivation, more organizational commitment, more satisfaction with interpersonal outcomes, a greater sense of accomplishment/growth for good work, and a greater likelihood of supervisory recognition for good work than did those at the second NARF. Also, they felt their jobs were more important and more meaningful, perceived their work groups as more cohesive and as exhibiting more concord and more group decision making, characterized their supervisors as both more considerate and more structuring, reported less impediments and more facilitation of their productivity, and perceived better job communication than did those at the second NARF. However, the technicians at the second NARF did find the physical characteristics of the work space more attractive than did those at the first NARF.

The large number of differences between the technicians at the two locations on the basic scales was also reflected in differences on the composite scales. The technicians at the first NARF reported more intrinsic job satisfaction, better supervision, better interpersonal climate, and better organizational climate than did the technicians at the second NARF.

Turnover Intentions Among Engineers

The five composite scales were used to predict turnover intentions among the engineers. The correlations (r 's) between the composite scales and turnover intention were $-.27$ for intrinsic job satisfaction, $-.34$ for supervision, $-.10$ for interpersonal climate, $-.15$ for organizational climate, and $-.29$ for material satisfaction. Table 5 provides the results of the regression analysis performed to find the best set of predictors. As shown, the supervision and material satisfaction scales, which had the strongest zero-order correlations, were, respectively, the first and second best predictors of turnover intentions.

Table 4
Comparison of Technicians at Two NARFs on
Basic and Composite Scales

Scale	First NARF (N = 63)	Second NARF (N = 53)	F
Basic Scales			
1. General attitudes			
a. Achievement motivation	6.29	5.99	4.60*
b. Organizational commitment	6.22	5.87	6.47*
2. Job facets			
a. Satisfaction with interpersonal outcomes	5.76	5.32	5.29*
b. Sense of accomplishment/growth for good work	5.08	4.63	4.09*
c. Supervisory recognition for good work	3.58	2.83	10.20**
3. Task and role characteristics			
a. Job importance	5.77	5.36	6.34*
b. Job meaningfulness	5.81	5.46	4.54*
4. Work group functioning			
a. Work group cohesion	5.11	4.70	4.32*
b. Work group concord	4.66	3.71	12.88**
c. Group decision making	4.91	4.12	12.91**
5. Supervisory behavior			
a. Consideration	4.98	4.38	7.69**
b. Initiating structure	5.24	4.58	8.80**
6. Organizational characteristics			
a. Lack of impediments to productivity	3.70	3.04	10.32**
b. Facilitation of productivity	4.37	3.92	4.37*
c. Good communication ^a	3.00	2.64	11.91**
7. Characteristics of the work space			
a. Desirability of the work space ^a	2.27	2.59	3.90*
Composite Scales			
1. Intrinsic job satisfaction	5.70	5.36	5.95*
2. Supervision	4.83	4.23	9.71**
3. Interpersonal climate	5.12	4.48	12.43**
4. Organizational climate ^b	3.44	3.08	6.80*

^aBased on a 5-point scale with a neutral point of 3.00.

^bRepresents the mean of three 7-point scales and one 5-point scale; it ranges from 1.00 to 6.50 with a midpoint of 3.75.

*p < .05.

**p < .01.

Table 5
Prediction of Turnover Intention Among Engineers

Scale	R	R ²	r
Supervision	.34	.11	-.34
Material satisfaction	.40	.16	-.29

Note. Analysis based on 95 respondents for whom complete data were available.

DISCUSSION

Attitudes Toward Work Life

General Attitudes

The general attitudes expressed by the present sample are congruent with those expressed historically by engineers. Traditionally, engineers report chronic frustration and general dissatisfaction with their jobs. Usually, they are only slightly more favorable toward their jobs than are assembly line workers and about as favorable as are low-level clerical workers. The low level of general job satisfaction expressed by engineers in this study is clearly in line with the traditional result.

Engineers often report stronger achievement needs than do nonengineers. The engineers and engineering technicians both reported more achievement motivation than did the mechanics. Thus, the result for achievement needs are also in line with the traditional result.

Engineers usually report as much organizational commitment as do other types of employees. All three occupational groups reported equally high amounts of organizational commitment. Thus, for job satisfaction, achievement motivation, and organizational commitment, the current attitudes expressed by government engineers are similar to those expressed by engineers over the last 30 years.

Job Facets and Task and Role Characteristics

In the present study, engineers reported that intrinsic job factors are very important to them; these factors were much more important to the engineers than to the other occupational groups. The engineers also reported significantly less satisfaction with intrinsic job factors than did the other groups. The reason for their dissatisfaction is reflected in their perceptions of their task and role characteristics. The engineers perceive their jobs as less important and meaningful than do the technicians, while they perceive their jobs to be no more challenging than those held by the technicians. Engineers also report experiencing less autonomy than the other groups. The lesser autonomy for the engineers is reflected by their perceptions of a more unfair workload, less self-control of workplace, and a greater need for cooperation and coordination to get their jobs done. These results for both the importance of and the satisfaction with intrinsic job factors are in line with those of previous research on engineers.

Pay and Performance

Establishing a fair rate of compensation for engineers is not easy. As noted by French (see Note 1).

In comparison with other types of jobs, responsibilities and standards of performance relating to engineering and scientific positions are less readily measured, relative job worth not so easily determined, and a rationale for promotion not so easily developed.

Thus, it is not surprising the engineers in the present study report significantly less ability to self-evaluate their own performance as well as less connection between both their individual and other pay determinants and their actual pay. In spite of receiving the highest average pay, engineers, compared with the other groups, are still the least satisfied with their pay level and perceive their pay level as more unfair. These negative attitudes toward pay and performance among the engineers are clearly in line with traditional results.

Physical Characteristics of the Work Space

Traditionally, engineers have complained about the common practice of having groups of engineers work in a large common room. In general, the engineers in the current sample are still housed in large common rooms and are still dissatisfied. It is interesting to note, however, that the attitude toward the physical work environment is one of the few where the engineers at the two NARFs differed significantly. The engineers at the second NARF were less dissatisfied than were those at the first NARF. This difference probably reflects the more widespread practice at the second NARF of using partitions to subdivide the large common spaces into cubicles with greater privacy. This finding suggests that something can be done to improve engineer satisfaction with the physical characteristics of the work space.

Turnover

In the present study, the best predictors of the turnover intentions among engineers were the perceived quality of supervision and material satisfaction. Traditionally, government scientists and engineers have listed two major reasons for quitting: Eighty percent cited opportunities to do important and interesting work in an environment of freedom and individual responsibility, while 60 percent cited inadequate compensation and lack of opportunity for advancement. The quality of engineering supervision can have a clear impact on both of these reasons for leaving. A supervisor in the Civil Service System does have some control over promotions, quality step increases, and other monetary bonuses. A supervisor can assign work that varies in intrinsic interest, while protecting the autonomy of his subordinates from excessive demands by intraorganizational customers. A supervisor can also assist his subordinates to get their jobs done by cutting through bureaucratic red tape and other impediments to productivity. Meanwhile, the material satisfaction scale measures both the satisfaction with pay as well as the physical quality of the work space.

RECOMMENDATIONS

It is suggested that:

1. The Office of Personnel Management consider further accelerating the pay schedule for engineers as a means to improve recruitment and increase retention.
2. Managers of Navy industrial facilities (a) attempt to improve the physical working conditions encountered by engineers (e.g., provide acoustical ceilings to reduce noise, dividers in open bays for privacy) and (b) examine supervisory practices to see if the quality of supervision can be improved.

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